REMARKS

Claim 20 has been amended to more clearly describe Applicants' invention. In particular, this claim has been amended to refer to the substantially globular lyogel rather than the lyosol. Support for this amendment can be found on page 6, 4th paragraph, as well as Example 1. New claim 27 has been added which recites an embodiment of the present invention wherein a hydrosol, formed from silicic acid and mineral acid, is used to for a substantially globular hydrogel which is then converted to an aerogel. Support for this new claim can be found throughout the specification and claims as originally filed, including, for example, page 7 and Example 1. No new matter has been added. Thus, claims 14-22 and 26-28 are pending.

Rejection of Claims under 35 U.S.C. § 103(a)

Marisic in view of Fernholz et al., optionally further in view of Mielke et al.

The Examiner has rejected claims 14-22 and 26 under 35 U.S.C. § 103(a) as being unpatentable over Marisic (U.S. Patent No. 2,384,946) in view of Fernholz et al. (U.S. Patent No. 3,939,199) and optionally further in view of Mielke et al. (U.S. Patent No. 5,656,195).

On page 1 of the Final Office Action, the Examiner states that Marisic discloses a process of producing hydrogel pellets by continuously contacting within an enclosed mixing chamber such as an injector or nozzle mixer, streams of reactant solutions of such concentration and proportions that no gelation occurs with the mixer, but only at some predetermined time after leaving the mixer, and under such conditions of flow that each stream is completely and uniformly dispersed with and throughout the other at the instant of contact. The Examiner also states that the resultant colloidal solution is ejected from the mixer through an orifice or orifices of suitable size so as to form globules of the solution which are introduced into a fluid medium where the globules of the colloidal solution set to a gel before they pass out of the medium. The Examiner further identifies other features of Marisic,

including the formation of pellets by a process analogous to spray drying wherein the gelable solution is sprayed into a drying tower, that the fluid medium, which may contain components, can be constituted of a gas such as air and is maintained at a temperature below the boiling point of the sol, and that the hydrogel can be produced from a solution of sodium silicate and hydrochloric acid. The Examiner concludes that it would have been obvious to one skilled in the art to select any embodiment among the specifically disclosed embodiments.

The Examiner also states that Marisic further discloses that the fluid medium is maintained at temperature below the boiling point of the sol and that, after setting is complete, the hydrogen may be washed, base exchanged, heat treated or otherwise processed to obtain the desired physical and chemical characteristics in the final product. The Examiner considers this product to be the same as the claimed aerogel since the resulting gel possesses open pores free of liquid. While the Examiner notes that Marisic does not specifically disclose the temperature of the process, the Examiner concludes that it would have been obvious to optimize these process conditions to obtain the best results. The Examiner also concludes that it would have been obvious to dry the hydrogel to obtain aerogel, since aerogel is desired in the art. The Examiner adds that, in the event that the heat treating step of Marisic is not sufficient to convert the hydrogel to aerogel, Mielke et al. teaches that silica aerogel particles, which are desired to be used in moldings, can be produced by solvent exchange and subsequent supercritical drying of a silica hydrogel. The Examiner therefore concludes that it would have been obvious to one of ordinary skill in the art to convert the hydrogel of Marisic to aerogel because aerogel is desired to be used in moldings as suggested by Mielke et al.

The Examiner also notes that Marisic does not disclose that the fluid is moving substantially against the direction of gravity. However, the Examiner states that Fernholz et al. discloses that for a spray-drying process for converting a sol to a gel, in order to avoid damage of the gelled and still soft particles, they can be sprayed in an upward inclined direction and collected in a liquid bath (for example water) or they can be conducted in counter current flow with a current of air or gas which reduces their impact velocity and simultaneously improves their resistance to drying. The Examiner therefore concludes that it

would have been obvious to one of ordinary skill in the art at the time the invention was made to use a current of air or gas in counter current flow with the spray of silica sol in the process of Marisic, as suggested by Fernholz et al. because such counter current flow of air would reduce the silica gels impact velocity and improve their resistance by drying.

Regarding claim 20, the Examiner further concludes that the subject matter as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to have used both the water bath and the counter current flow of air to avoid damage of the gelled and still soft particles, because combining two or more ways as disclosed in Fernholz et al. for the same purpose has been held to be a prima facie case of obviousness.

On pages 4-5 of the Final Office Action, the Examiner addresses Applicants' previous arguments. In particular, regarding Applicants' argument that Marisic does not disclose that the fluid is moving substantially against the direction of gravity, the Examiner states that, in one embodiment of Marisic, the colloidal solution can flow upward during gelation. Regarding Applicants' argument that Fernholz et al. is not analogous art to Marisic and that one skilled in the art would not be motivated to combine these references, the Examiner agrees that the sol or gel of Fernholz et al. is not silica as in Marisic. However, the Examiner further states that both Fernholz et al. and Marisic et al. deal with a problem concerning possible damage when converting soft sol into a gel and Fernholz et al. fairly suggests a solution for such a problem. The Examiner therefore concludes that it is clear that Fernholz et al. is reasonably pertinent to the particular problem with which the inventor was concerned. Finally, regarding Applicants' argument that Fernholz et al. is not a sol but "the gelled and still soft particles", the Examiner states that, during step ii) of Applicants' claims 26 and 27, a gel would be formed, just the same as the "gelled and still soft particles" as disclosed in Fernholz. The Examiner therefore concludes that it would have been obvious to one skilled in the art to prevent damage to the gel from the beginning, i.e., from the original sol to the final gel.

Applicants respectfully disagree. Regarding claims 14-22 and 26, claim 26 recites a method of producing substantially globular aerogels wherein i) gel forming components are mixed to produce a lyosol, ii) the lyosol is introduced into a moving medium which flows

substantially against the direction of gravity to form a substantially globular lyogel, and iii) the substantially globular lyogel is converted to an aerogel.

The Examiner has applied Fernholz et al. for the countercurrent flow method used to minimize damage to the described "gelled and still soft particles", stating that it would have been obvious to use this method in the process of Marisic because such countercurrent flow would reduce the silica gels' impact velocity and would improve their resistance by drying. However, Applicants believe that these references would not be combined by one skilled in the art.

Both Fernholz et al. and Marisic relate to very different types of particles. In Fernholz et al., various methods are described to form "larger balls, tablets, or granules suitable for the manufacture of catalysts" from smaller "particles without pores" (see column 1, line 66 and column 2, lines 10-19). One method involves making a paste of the powdery mass with a dilute solution of a mineral glue, capable of being transformed into a difficultly soluble form by burning (see column 2, lines 10-17). Alternatively, particles made into a paste with an aqueous sol can be suspended in a solvent or diluent immiscible with water and the sol can be allowed to gel (see column 2, lines 119-22). Another described method is spraying a thin paste of the particles in a sol through a nozzle and allowing the sol to gel in the free fall (see column 2, lines 23-25). Thus, in all cases, the particle that is prepared in Fernholz et al. is a mixture of "particles without pores" held together by a sol that gels and acts as a glue, and the countercurrent flow is described only for these types of particles in order to "avoid damage of the gelled and still soft particles".

By comparison, Marisic describes a process of producing hydrogel pellets by continuously contacting, within an enclosed mixing chamber, streams of reactant solutions of such concentration and proportions that no gelation occurs with the mixer. The resulting colloidal solution is ejected from the mixer so as to form globules of the solution, which sets to a gel before they pass out of the medium. Thus, Marisic teaches introducing a sol (specifically, a hydrosol) into a vapor atmosphere.

Clearly the particles of Fernholz et al. are not the hydrosol or hydrogel pellets of Marisic, and the Examiner has acknowledged this on page 4, last paragraph of the Final Office Action. However, the Examiner also states that, since both Fernholz et al. and Marisic each deal with a problem concerning possible damage when converting soft sol into a gel, and Fernholz et al. fairly suggests a solution for such a problem, the Examiner concludes that it is reasonably pertinent to the particular problem with which the inventor was concerned.

However, Applicants believe that one skilled in the art would not apply the countercurrent flow of Fernholz et al. to the sol or gel of Marisic. Rather, Applicants believe that Marisic clearly teaches that such a countercurrent flow would not be possible with the gels prepared in the described process. For example, Marisic teaches that "it is essential to the formation of a structurally strong pellet that the sol not be mechanically disturbed during the time of setting" (see page 2, second column, lines 2-5). Even evaporation of water from the sol "disturbs the gel structure during formation" (see page 2, second column, lines 5-14). Also, the shape of the formed gel is affected by the type of fluid medium and the rate at which the colloidal solution travels through it (see page 2, second column, lines 56-66). Thus, the globules of the sol can result in gel having flat or disc-like shapes, depending on the medium, thereby loosing their spherical shape.

Thus, since Marisic clearly teaches that the spherical sols become damaged or can lose their shape if mechanically disturbed, one skilled in the art would avoid using any method which would disturb the sol. This would include the countercurrent flow of Fernholz et al., which has been taught as being applicable only to mixtures of "particles without pores" held together by a mineral glue. Since, as described in the present application, the "particular problem with which the inventor was concerned" is stated as "providing a method of producing substantially globular lyogels" [emphasis added] (see page 5, first paragraph), Applicants believe that the teaching of Marisic relating to silica sols and gels teaches away from using methods such as shown in Fernholz et al. and, in fact, would lead one skilled in the art to avoid such methods.

Regarding Mielke et al., Applicants believe that this reference also cannot cure the deficiencies of Marisic. In particular, while Mielke et al. shows that a silica aerogel can be produced by solvent exchange and subsequent supercritical drying of a silica hydrogel, there is no teaching or suggestion anywhere in Mielke et al. of a process in which a lyosol is introduced into a medium which flows substantially against the direction of gravity. Furthermore, the Examiner states that this reference teaches that aerogel particles are desired to be used in moldings. However, none of the present claims recites a molding.

Therefore, since Marisic cannot be combined with Fernholz et al. and since Mielke et al. cannot cure the deficiencies of Marisic, Applicants believe that claim 26 is patentable over Marisic in view of Fernholz et al. and optionally further in view of Mielke et al. Claims 14-22, which depend either directly or indirectly from claim 26, recite further embodiments of the present invention and, for at least the reasons discussed above, are also patentable over this combination of references.

Applicants therefore believe that claims 14-22 and 26 are patentable over Marisic in view of Fernholz et al., optionally further in view of Mielke et al. and respectfully request that this rejection be withdrawn.

Regarding new claim 28, this claim recites a method of producing substantially globular aerogels wherein gel forming components are mixed to produce a hydrosol, the hydrosol is introduced into a moving medium which flows substantially against the direction of gravity to form a substantially globular hydrogel, and the substantially globular hydrogel is converted to an aerogel. The hydrosol is formed from silicic acid and mineral acid, and the substantially globular hydrogel is trapped in a layer of water. Applicants believe that new claim 28 is also patentable over Marisic in view of Fernholz et al., optionally further in view of Mielke et al. for at least the reasons discussed above. In addition, there is no disclosure in Fernholz et al. of either the formation of a hydrosol from silicic acid and mineral acid or of trapping substantially globular hydrogels in a layer of water. Therefore Applicants believe that claim 28 is patentable over this combination of references.

Marisic in view of Fernholz et al. and Frank et al.

The Examiner has rejected claim 27 under 35 U.S.C. § 103(a) as being unpatentable over Marisic (U.S. Patent No. 2,384,946) in view of Fernholz et al. (U.S. Patent No. 3,939,199) and Frank et al. (U.S. Patent No. 5,789,075).

On page 4 of the Final Office Action, the Examiner states that Marisic and Fernholz et al. are applied as stated in the above rejection and notes that the difference not yet discussed is that Marisic does not teach the silylation step. For this reason, the Examiner refers to Frank et al, stating that this reference discloses that the term aerogel encompasses xerogels and cryogels and that it is known in the art to convert gels into xerogels by modifying the gels by silylation in such a way that the gels can be dried without collapsing. The Examiner therefore concludes that it would have been obvious to one of ordinary skill in the art to convert the gel of Marisic into an aerogel (i.e., xerogel) by first silylating the gel, as suggest by Frank et al. in order to dry the gel without collapsing the gel structure because Frank et al. teaches that aerogel is a desired product in the art.

Applicants respectfully disagree. As discussed in more detail above, Applicants do not believe that one skilled in the art would combine Marisic and Fernholz et al. since each of these reference relate to very different types of particles. Furthermore, the clear teaching of Marisic would lead one skilled in the art to avoid the countercurrent flow method of Fernholz et al. since such a process would be expected to damage the sol as it sets to a gel.

Furthermore, regarding Frank et al., Applicants believe that this reference cannot cure the deficiencies of Marisic. In particular, while Frank et al. does disclose that hydrogels may be modified by silylation, there is no teaching or suggestion anywhere in Frank et al. of a process in which a lyosol is introduced into a medium which flows substantially against the direction of gravity.

Therefore, since Marisic cannot be combined with Fernholz et al. and since Frank et al. cannot cure the deficiencies of Marisic, Applicants believe that claim 27 is patentable over Marisic in view of Fernholz et al. and Frank et al. and respectfully request that this rejection be withdrawn.

Regarding new claim 28, this claim recites a method of producing substantially globular aerogels wherein gel forming components are mixed to produce a hydrosol, the hydrosol is introduced into a moving medium which flows substantially against the direction of gravity to form a substantially globular hydrogel, and the substantially globular hydrogel is converted to an aerogel. The hydrosol is formed from silicic acid and mineral acid, and the substantially globular hydrogel is trapped in a layer of water. Applicants believe that new claim 28 is also patentable over Marisic in view of Fernholz et al., optionally further in view of Mielke et al. for at least the reasons discussed above. In addition, there is no disclosure in Fernholz et al. of either the formation of a hydrosol from silicic acid and mineral acid or of trapping substantially globular hydrogels in a layer of water. Therefore Applicants believe that claim 28 is patentable over this combination of references.

Conclusion

In view of the foregoing remarks, Applicants believe that this application is considered to be in good and proper form for allowance, and the Examiner is respectfully requested to pass this application to issue. If, in the opinion of the Examiner, a telephone conference would further expedite the prosecution of the subject application, the Examiner is invited to call the undersigned.

Respectfully submitted,

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